

Before the  
Federal Communications Commission  
Washington, D.C. 20554

In the Matter of: )  
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Digital Audio Broadcasting Systems ) MM Docket No. 99-325  
And Their Impact on the Terrestrial )  
Radio Broadcast Service )

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**Comments of Timothy C. Cutforth**

The following comments are filed on behalf of Timothy C. Cutforth, P.E. (“T. Cutforth”) in response to the Commission’s Further Notice of Proposed Rulemaking and Notice of Inquiry in the above captioned matter. T. Cutforth is the applicant for several AM stations and is actively involved in the expansion and development of AM facilities. T. Cutforth is a professional engineer licensed in the state of Colorado and is the president and technical director of Vir James Engineers with offices at 965 S. Irving Street Denver, Colorado. Vir James Engineers has prepared applications for about 1000 AM stations over the last 50 years. T. Cutforth received his First Class Radiotelephone license in 1967 and has worked in broadcasting since that date in transmitter and studio maintenance, systems installation, and engineering consulting. T. Cutforth has done numerous field installation of AM directional systems and has installed specialized RF and audio processing equipment to optimize AM analog coverage areas for more than 100 of his clients.

**AM IBOC NIGHTTIME OPERATION**

T. Cutforth supports the rapid and voluntary introduction of spectrum efficient digital broadcasting on the AM band. However I believe that it is critical that a hybrid system compatible with the approximately 800 million analog receivers be required at the outset and

continue until digital receivers replace the bulk of the existing receivers. However, I believe that the introduction of hybrid analog/digital systems on the AM band during the nighttime should be permitted ONLY where the broadcaster can show that the hybrid facilities will not create additional interference to existing stations either co-channel or adjacent channel, daytime or nighttime. Nighttime interference already severely limits coverage of most AM stations nationwide.

### **FCC INTERFERENCE REDUCTION MANDATES VS DIGITAL**

After the FCC AM Interference Reduction rule makings of the 1990's which culminated in prohibiting new nighttime interference increases at the 25% RSS level it would be ludicrous to require protection of existing analog coverage to the 25% RSS level by analog signals while yet allowing destructive interference beyond that same 25% level by digital signals. In addition since the Ibiquity HD RADIO system as presently approved puts significant energy on the second adjacent channel it would be necessary to consider the digital energy on both the first adjacent and the second adjacent channel to insure that the FCC mandated AM interference control scheme is not destroyed by the indiscriminate introduction of AM hybrid operation without regard to interference.

Since the issuance of the Commission's interim order in this matter, deployment of AM digital operation has been rather slow. Ibiquity has indicated in press releases that approximately 30 AM stations are on air with the AM digital hybrid system, Radio World, May 19, 2004, pages 17-19. Recently published reports indicate that some stations have turned off their daytime IBOC signals out of concern for interference to adjacent channels providing service to their same market, *Antenna, Power Issues Emerge for AM IBOC*, Radio World, May 19, 2004.,

page 14. I have observed one such situation myself. When a local station put on their IBOC system, a second adjacent station whose 0.5 mV/m contour passes right through the center of town was effectively wiped off the dial for about 15 miles North of town. This eliminated about 80% of the population within the second adjacent station's 0.5 mV/m contour and most of the advertisers he was selling to. Because of this complaint and a lack of digital radio receivers that IBOC station decided to turn the digital signal off after about 2 weeks of operation. Lack of proof that the Ibiquity hybrid IBOC system can operate within the Commission's current allocation scheme without causing destructive interference even when operating within the present occupied bandwidth rules, together with the lack of night time operation authority has hindered the introduction of AM digital systems. As the Commission is well aware, since 1992, AM stations seeking to change their nighttime facilities have been required to reduce their existing RSS contribution by 10% if they are a contributor to the 50% night limit exclusion and to not increase the 25% RSS contribution both cochannel and on first adjacent channels. Daytime operation presents similar interference reduction requirements since due to rule changes over the years, significant areas of daytime prohibited contour overlap exist. The present Commission rules prohibit *any* increase in existing prohibited overlap. All this has added to the uncertainty facing those who seek to convert to digital operation.

### **DIGITAL SIGNALS UNDER ANALOG ALLOCATION RULES**

A large part of this uncertainty in the interference performance of hybrid digital broadcasting is the direct result of the application of Commission's rules developed for a broadcast service transmitting an amplitude modulated signal to transmission modes not in existence at the time the research was done nor were those transmission modes in existence when

those rules were written. In particular, the emission limits specified in 47 CFR 73.44 will not provide similar first or second adjacent channel protection if applied to any transmission method other than amplitude modulation with 10 kHz audio bandwidth. There is a significant energy difference between the occasional analog peaks caused by program audio overshoots as observed over the five to ten minute period contemplated when section 73.44 was drafted and digital carriers occupying the same bandwidth with highly repetitive nearly continuous peaks at that same level.

Although the power represented by these adjacent channel digital carriers is capable of being calculated with certainty, the audible effects are not directly comparable with adjacent channel speech peak energies at the same peak level. Without considerable research into the effect on listeners, the best analysis we can achieve is an RSS analysis of these adjacent channel signals to determine if the insertion of these adjacent channel digital carriers will fit the Commission's existing allocation scheme.<sup>1</sup> If it is determined that the adjacent channel energy created by use of the Ibisquity hybrid analog/digital system will enter the 25% RSS night limit of a station operating on the first adjacent channel, the station proposing digital operation should be required to reduce power in that digital sideband until the signal fits within the existing protection requirements.

T. Cutforth believes that reducing the digital sideband power to remain below the present 25% contribution limits of adjacent channels stations will permit the introduction of digital nighttime operation in an orderly fashion without abandoning the FCC mandate to reduce interference levels nationwide (or at least to prevent increases in interference at the existing 25% RSS level).

## **UNEXPECTED INTERFERENCE AND SUBJECTIVE STANDARDS**

The NAB has filed a proposal, which recommends that the Commission permit nighttime digital operation for all stations currently authorized for nighttime broadcasts without prior Commission authorization. The proposal also asks the Commission to resolve cases of “unexpected interference.” on a case by case basis.<sup>2</sup> This “buy now, pay later” approach simply increases the uncertainty for each broadcaster seeking to move forward with digital broadcasting and increases the number of disappointments possible to broadcasters and to the listening public during the hybrid transition. A broadcaster with limited resources would have to question the cost to benefit analysis when there remains a possibility that some unknown person’s subjective opinion concerning interference levels received could very well shrink their digital coverage after the startup. Further, without rules specifically crafted for application to a hybrid analog/digital system, the Commission is placed in the awkward position of trying to invent a new subjective standard to determine what actually constitutes “unanticipated interference.” What will the Commission be able to say if the final conclusion is that the problem is not “unexpected interference” but if instead it is found later that interference levels have increased for many stations and would just have to be tolerated? “Tough luck?” or “Too Bad So Sad!” will not be satisfying replies to the stations so damaged or to the public that has lost a favorite local service.

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<sup>1</sup> For instance, a 50 kW station operating in the hybrid mode with digital carriers –25 dB down from the main carrier will produce adjacent channel signals at 160 watts. At –28 dB, the power of the digital carrier is approximately 80 watts.

<sup>2</sup> Recommendations of the National Association of Broadcasters, dated March 5, 2004.

## UNEXPECTED INTERFERENCE CONFIRMED BY STUDIES

The NAB proposal and Ibiquity's AM Nighttime Compatibility Studies<sup>3</sup> indicate that interference can be expected outside of a station's Night Interference Free (NIF) limit. In practice, the usable nighttime signal of a great many stations operating in the analog mode presently extend well beyond the NIF contour. Many stations (perhaps a majority of stations), especially those licensed to suburban cities in a metropolitan area have substantial portions of their nighttime audience outside of their NIF. The public interest is not served by an unrestrained increase in interference that reduces the number of voices available to a large portion of the listening public.

In its initial order authorizing interim IBOC operations, the Commission agreed with the NRSC, that due to the lack of nighttime test results, significant uncertainty remained with respect to the potential for first adjacent channel interference during nighttime skywave propagation conditions.<sup>4</sup> The subsequent studies conducted by Ibiquity have confirmed the potential for significant nighttime interference in real world situations. As a result, considerable uncertainty surrounding the practical interference impact of HD RADIO IBOC operation at night still exists.

To define and limit this uncertainty, T. Cutforth encourages the Commission to adopt an interim policy permitting hybrid analog/digital operation upon a showing by the applicant that the proposed operation, when examined on the basis of the main channel and each adjacent channel digital carrier, will not increase nighttime interference for either the main or adjacent channel operations .

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<sup>3</sup> *AM Nighttime Compatibility Study Report*, Ibiquity Digital Corporation, dated May 23, 2003; *Field Report-AM IBOC Nighttime Performance*, October 20, 2003; *Field Report-AM IBOC Nighttime Compatibility*, October 31, 2003.

<sup>4</sup> *Digital Broadcasting Systems and their Impact on the Terrestrial Broadcast Service*, 17 FCC Rcd 19990, 20004 (2002) , at paragraphs 19-21.

## **Improvement of the IBOC Standard**

The Commission has chosen in-band-on-channel technology as the route for introducing digital operation on the AM and FM bands. The present embodiment of IBOC hybrid digital/analog system proposed by Ibiquity at the current state of development and power levels is not spectrum efficient. In comparison the Ibiquity AM IBOC system uses a 64k data rate which is only slightly faster than a standard POTS dial up modem operating over a 3 kHz audio channel while The Ibiquity system spreads its data out from 5 kHz to 15 kHz on each side, a 20 kHz total bandwidth used. Because the Ibiquity system places significant digital data beyond the assigned +/-10 kHz band reserved for analog audio modulation there will be additional potential for interference to the first adjacent channel and even to the second adjacent channels. Ibiquity's own studies indicate that adjacent channel interference will result. These interference limitations are not necessarily representative of digital broadcasting systems as a whole or other hybrid systems that may be developed.

## **WHAT LEVEL OF STANDARDIZATION IS REQUIRED FOR DIGITAL SUCCESS?**

Far different from the past age of "AM STEREO" when ALL receivers were hardware determined and could not be reasonably adapted to receive any signal beyond the original receiver design, the state of the art receiver is today based on a programmable DSP chip and can be rapidly reprogrammed to detect and decode practically any modulation pattern imaginable within its receive bandpass. The Wireless Bureau is just now preparing rules for software defined two way radio units that are programmed to match the radio to the frequency, modulation mode, and bandwidth as required by the license document. Already some compact size Ham Radio sets have keyboard entry selection of operating bands from 1.8 MHz to 432 MHz with CW, AM, SSB, FM (with both wide band and narrow band receive), SSTV, packet and

other digital modes of communication , all available at the touch of a button on demand.

Broadcast receivers will follow close behind the two way industry since programmable technologies will reduce the number of different receiver chassis that will be necessary to manufacture to meet multiple needs and provide many options. Additionally such programmable radios will easily avoid obsolescence of radios already delivered to the store shelves and purchased by consumers. Manufacture of hardware defined radios to accomplish digital decoding will be shown to be spectacularly inefficient, subject to untraceable and unrepairable bugs, and unable to cope with the slightest data encoding upgrade. Therefore if it is attempted to manufacture hardware defined digital radios such attempts will be abandoned very early on as a boondogle.

Therefore we must ask the question exactly what items MUST BE fixed by law to insure a successful transition to digital broadcasting? Is it the number of digital subcarriers, the exact frequencies of each digital subcarrier, the data rate, or the specific encode/decode algorithms (which I remind you have already been changed by Ibiquity since the FCC order allowing interim operation of the Ibiquity hybrid IBOC system) ? Is it necessary for the FCC to specify that only digital broadcast exciters licensed to use the Ibiquity patents can broadcast digital data which decodes as program audio? And if so exactly which Ibiquity patents? If only the present Ibiquity patents are allowed Ibiquity will be placed in a straitjacket and will be unable to benefit from future improvements of their own system. Such an absurd level of restriction of the state of the art would be found to be counterproductive in a very short time. Where would computers be today if a law had restricted us to 286 processors at 30 mHz and Dos 6.22, or 386 processors at 50 mHz and Windows 3.1? How could anyone have the patience to surf the Internet if we were

stuck with 1200 baud modems that snap onto the telephone handset as were the standard (set in the law) in the 1970's?

Although there are some benefits to tightly standardizing in the short run, restriction on the application of technological innovation will severely limit public benefits in the long run.

### **BANDWIDTH OCCUPANCY IS THE APPROPRIATE DEFINING STANDARD**

I believe that the Commission need only impose the bare minimum limitation on technology necessary to prevent causing new or increased levels of interference beyond the FCC's carefully determined standards. I propose that the maximum bandwidth specification for IBOC hybrid transmission is the appropriate technical specification to define allowable digital broadcasting modes (preferably in an easily understood form comparable to the "NRSC mask" for analog broadcasting specified in Section 73.44). The maximum bandwidth occupied by actual digital data transmission plus a description of the maximum incidental energy outside of the actual data bandwidth will adequately define the bounds of digital hybrid broadcasting. Each exciter manufacturer should be required to certify by factory measurement that the digital exciter meets such bandwidth limitations as delivered. The broadcast station should be required to measure compliance with that same standard when the system is installed and at least annually as is now required in Section 73.44 for analog operation. New digital allocations rules are needed to specifically include the digital subcarrier energies beyond the present +/-10 kHz analog bandwidth. Where second adjacent stations are serving some of the same area in their primary 0.5 mV/m contour the digital sideband level on the sideband towards the second adjacent channel station should be required to be more than the minimum 35 dB down (presently specified in the NRSC mask for analog broadcasting) to maintain at least a 20 dB D/U ratio in

the overlap area where actual interference to listener within the primary coverage contour and outside of the IBOC station's analog 25 mV/m contour . Such additional suppression is anticipated and called for in Section 73.44 c) whenever emissions outside of the 10 kHz audio bandpass causes actual interference to analog reception.

In this age of software driven receivers there is no need to set into law any particular transmission method or encoding/decoding method when a receiver can be shifted to another mode by a firmware or software change.

### **LIMITATIONS IN TECHNOLOGY UPGRADABILITY ARE UNDESIREABLE**

The Ibiquity system has itself already been subject to several updates in its encoding/decoding methodology. T. Cutforth would urge the Commission to adopt rules which will permit innovation and further development of in-band-on-channel digital technology while protecting actual existing analog service from significant new interference, whether those innovative techniques be developed by Ibiquity or any other concern as long as there are specific benefits to the public either in attainable data rates, improved audio quality in the hybrid mode either analog or digital, improved spectrum efficiency, or decreased interference in actual operation.

### **MULTICASTING**

I believe that some level of multicasting is inevitable since once a data stream is added to a broadcast station, it is reasonable and practical to assign any desired number of the available bits to any desired purpose. The state of the art decoder should be able to read the encoder mode and properly parse the data to provide the service or services desired. Public Radio has already shown the possibility of such split channel operation on FM as well as demonstrating the technology to accomplish it. Public demand for digital services will vary from region to region.

Some stations may chose to broadcast analog audio accompanied by a digital data stream which is used for data delivery only. Some stations may wish to split their digital data among two or more program feeds to meet local demand for specialty programming. It would be wasteful to require a station broadcasting monaural speech programming to waste a 15 kHz stereo capable digital data stream to accomplish 3 kHz monaural speech just in order to force uniformity in the initial adoption of equipment and software. During the initial transition period I recommend that the primary digital audio channel be duplicated on the analog channel to provide blend to analog backup and to provide the analog listener access to the most desired channel.

## **SUMMARY**

In summary I request that in keeping with the FCC mandate to reduce interference on the AM band nighttime operation of IBOC hybrid digital broadcasting should be allowed only with a showing that the additional energy in the digital sidebands does not enter into the 25% RSS of the adjacent channel stations.

I propose that both daytime and nighttime allocation rules be developed specifically for digital operation taking into account the additional coherent data energy in the second adjacent channel which is far more destructive than the occasional momentary peaks caused by analog broadcasting. This will eliminate uncertainty presently preventing ready adoption.

I propose that a specific digital broadcasting emission standard be adopted as the primary standard that defines hybrid digital broadcasting. This will adequately guarantee that digital broadcasting continues to follow the direction of choice, IBOC.

I request that the minimum federal limitations be applied to the exact technologies of digital broadcasting so that the broadcasters and the public can benefit from incremental changes in digital broadcasting technology in a timely fashion.

I propose that the broadcaster be allowed to subdivide his digital channel in whatever fashion makes the most sense to him in order to best serve his local market including multiplexing or sales of data bandwidth with the exception that during the transition period, the primary digital audio channel shall be duplicated on the analog channel.

Respectfully submitted,

Timothy C. Cutforth P.E.